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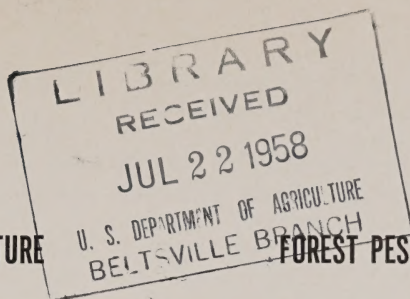
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Forest Service

FOREST PEST LEAFLET 24

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California Flatheaded Borer

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The California flatheaded borer (*Melanophila californica* Van Dyke) has been responsible for the death of much fine Jeffrey and ponderosa pine in the West. In California alone, it kills an estimated 30 million board-feet each year. The insect is found in Idaho, Washington, Oregon, California, and Nevada (fig. 1) but is most common in Idaho, Oregon, and California. Most of what is known of the insect's biology has been learned from studies in California, where it is most destructive. Here, conditions favorable to the insect are common in pine stands along the east slopes of the Sierra Nevada and Cascade Range, in the foothills of the Sierra Nevada and Coast Ranges, and in the mountains of southern California. Most frequently it infests pines growing on shallow or rocky soils in stands at the fringe of forest areas where rainfall is light, but it also attacks stands on better sites.

The flatheaded borer is a serious pest and is capable of killing a tree outright. Usually, though, the insect is found in a tree along with other serious pests: the western pine beetle (*Dendroctonus brevicornis* Lec.), the Jeffrey pine beetle

(*D. jeffreyi* Hopk.), and pine engravers (*Ips confusus* (Lec.) and *I. oregoni* (Eichh.)). The borer often attacks the tree first, and predisposes it to further attack by *Dendroctonus* beetles. A tree that survives attacks by the borer may subsequently be killed by bark beetles. Trees top-killed by pine engravers may be killed by supplementary attacks of the borer in the lower crown and bole.

Hosts

The California flatheaded borer primarily attacks ponderosa pine (*Pinus ponderosa* Laws.) and Jeffrey pine (*P. jeffreyi* Grex. & Balf.). In stands composed of a mixture of these two species, the insect is more often found in Jeffrey pine. Records show it also attacks sugar pine (*P. lambertiana* Dougl.), Coulter pine (*P. coulteri* D. Don), Monterey pine (*P. radiata* D. Don), Digger pine (*P. sabiniana* Dougl.), and knobcone pine (*P. attenuata* Lemm.).

The flatheaded borer usually attacks living trees, but continues its development in these trees when they are felled or when they are killed by bark beetles or other agents. Borers may also continue their development in tops and limbs left as slash after a logging operation. Although the beetle

¹ Maintained by the Forest Service, U. S. Department of Agriculture, at Berkeley, Calif., in cooperation with the University of California.

may sometimes attack dead trees or slash, survival in dead material is uncertain.

The beetle attacks the entire length of the bole of the host tree and the basal parts of heavier limbs. It can also infest only a part of a tree, like the top, the mid-bole, or a strip on one side.

The California flatheaded borer attacks living hosts of all size classes above the sapling or pole stage. The insect is more commonly found in trees that are declining in vigor. Many of these trees are infested with young borer larvae. Estimates of the proportion of such trees infested run as high as 75-80 percent in some California localities.

Evidence of Attack

The general appearance of an infested tree is not always a reliable guide to the insect that has attacked it. This is so because trees showing symptoms of poor vigor are a suitable food source for bark beetles as well as for the borer. Some trees are attacked repeatedly by the borer and yet do not die. When repeated attack is sustained for several years, however, the tree shows a progressive decline. Decline in vigor is usually expressed by thin crowns, shorter and fewer needles, dead limbs in the living crown, and yellowish-tinted foliage (fig. 2).

Concrete evidence of flatheaded borers in trees of poor vigor can be

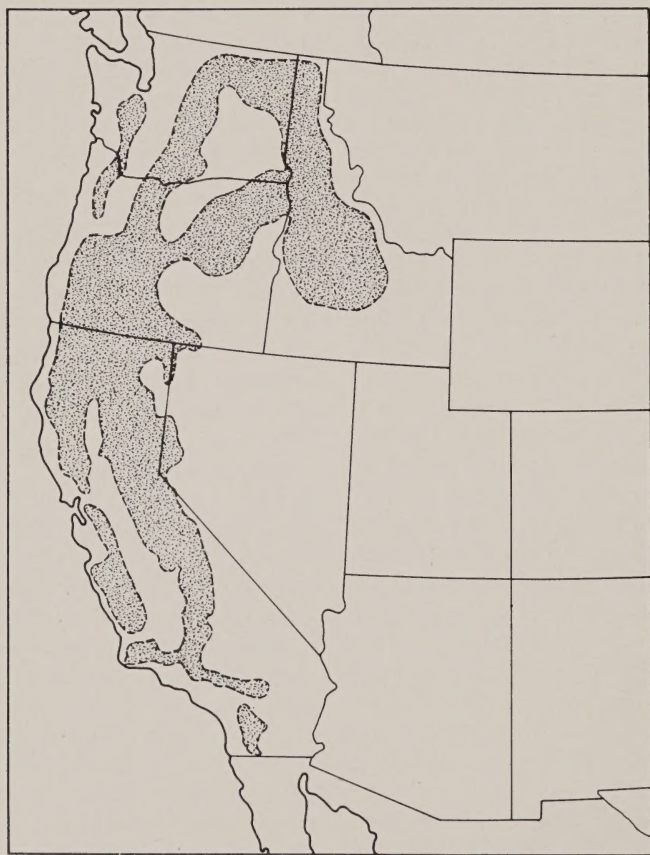


Figure 1.—Distribution of the California flatheaded borer.

found by peeling off a section of bark. If the flatheaded borer has attacked the tree, the surface of the exposed wood will have winding, warty ridges one or more inches long (fig. 3, *B*). These narrow, linelike ridges are formed when new wood grows over the tiny galleries produced by young flathead larvae feeding on the innermost bark tissues lying next to the wood. The healed-over larval galleries may be numerous over the exposed wood, and their mirror image will be seen as an impression on the opposing bark surface.

When the tree dies from flathead attacks, its foliage first turns yellowish green. Later, the foliage turns straw color, then reddish brown to brown. Usually, the borer has matured and emerged from the tree before the foliage turns reddish brown; occasionally it emerges before the foliage turns straw color or when it is only beginning to show a yellowish cast. Small oval exit holes opening at the bark surface are evidence that the adults have abandoned the tree (fig. 3, *C*).

In dead or dying trees, the presence of flatheaded borers is shown by galleries on the inner surface of the bark, which are made by the larger maturing larvae. These galleries wind about through the tissues lying next to the wood, at times occupying most of the inner bark surface. They are mostly 10 to 15 millimeters wide and are packed solid with larval excrement, deposited in a clearly defined, concentric, crescent-shaped pattern (fig. 3, *A*).

The work of the California flatheaded borer may be confused with that of the pine flatheaded borer (*Melanophila gentilis* Lec.) since the two species have common hosts. The pine flatheaded borer does not attack living trees but develops in felled logs and slash or in wind-falls and other dead or dying trees.

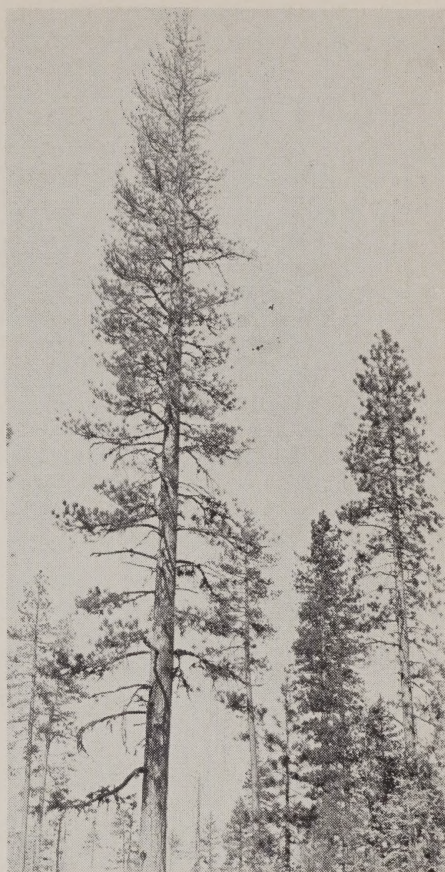


Figure 2.—Decline in vigor of ponderosa pine often associated with repeated flatheaded borer attacks.

There are no healed-over galleries since the host is dead or dying when attacked by the pine flatheaded borer.

Life Stages

The adult is 7 to 11 millimeters long, 3 to 4 millimeters wide, elliptical, brownish black and bronzed above and brassy green below (fig. 4, *A*). About 60 percent of the adults have 1 to 3 yellow spots on each wing cover. Forty percent have none. The pine flatheaded borer, on the other hand, is a bright blue green with unspotted elytra.

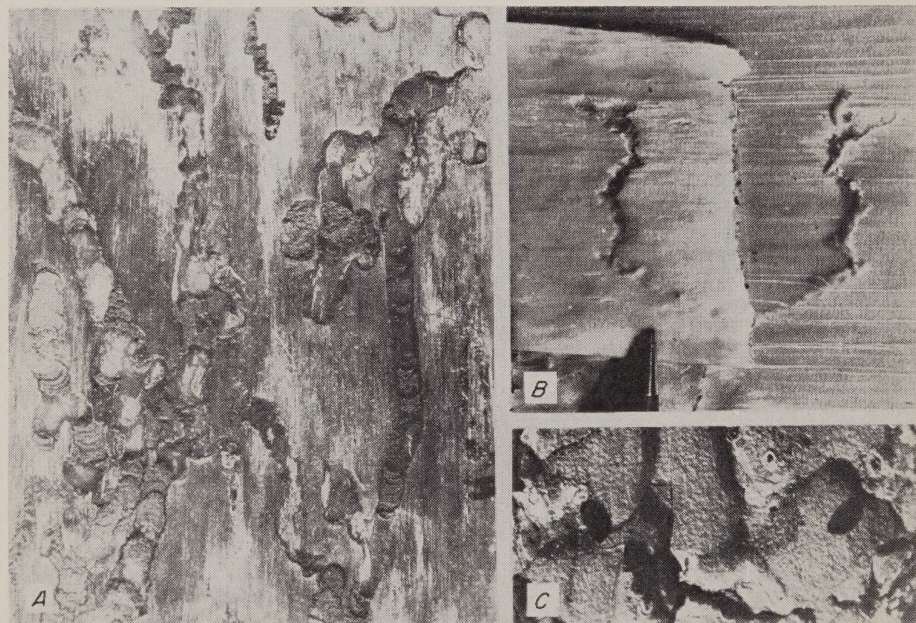
The eggs of the California flat-headed borer are a creamy white when first laid, turning yellowish with development. They are generally flattened and oval in outline (fig. 4, *D*). Most of them are about 1 millimeter long and $\frac{2}{3}$ millimeter wide.

The young larvae are creamy white with a tinge of brown. They blend with the wood and phloem of the infested tree and are difficult to see. The forepart of the larva's body is slightly enlarged laterally, giving it a "horseshoe-nail" shape characteristic of the family Buprestidae. In the older larvae, the forepart of the body is much enlarged. The full-grown larva (fig. 4, *E*) is creamy white and about 25 millimeters long. In the last instar (prepupal) the larva shortens, thickens greatly, and its body bends double (fig. 4, *F*).

The pupa is the same size as the adult. It is translucent white at first, changing to the adult color as it develops. The antennae, wings, and upper surface of the abdomen remain a clear, translucent white until just before the pupa becomes an adult (fig. 4, *B* and *C*).

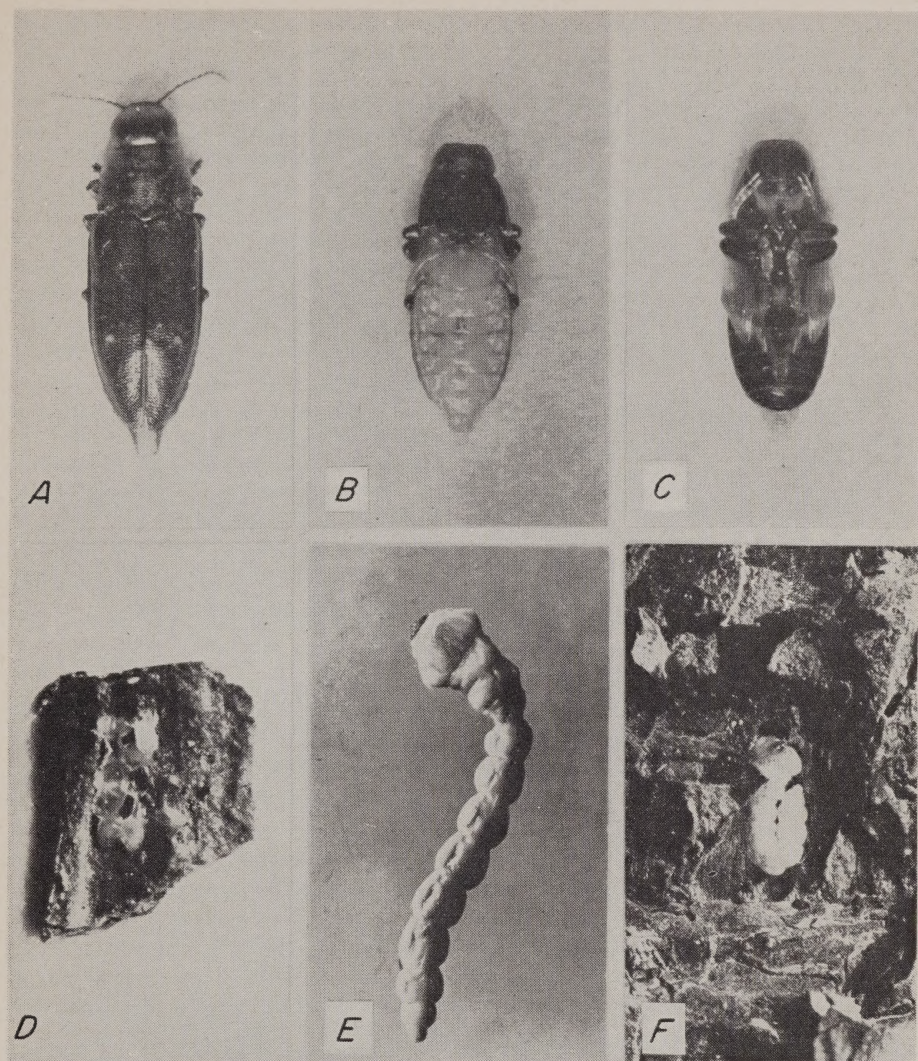
Habits

The adult beetles emerge from May to August, and the peak of emergence is usually in June or July. The peak and the spread of emergence, however, may differ in the different parts of the insect's range, especially from north to south, and at various elevations. Local weather conditions also have a profound influence on adult emergence and may greatly delay or accelerate it.



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Figure 3.—Evidence of attack by the California flatheaded borer: A, Galleries of maturing larvae on the inner bark surface ($\times \frac{1}{3}$); B, left, exposed mine of a young larva showing the partially healed mine in the bark; right, the same mine in the wood with the larva at its terminus ($\times \frac{2}{3}$); and C, exit holes in the outer bark made by the adult ($\times \frac{1}{3}$).



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Figure 4.—Life stages of the California flatheaded borer: A, Adult ($\times 4$); B, pupa, dorsal view ($\times 3$); C, pupa, ventral view ($\times 3$); D, eggs on underside of a bark scale ($\times 4$); E, full-grown larva ($\times 3$); F, prepupal larva in outer bark ($\times 2$).

When the adults emerge, they fly to green host trees and feed on the foliage. Foliage feeding is necessary if the female is to develop viable eggs. The adult clings to the needle sheath, or just above it, and feeds on the exposed fascicle of needles, usually of the current season's growth. Most feeding is confined to the lower inch of the ex-

posed needle although feeding elsewhere along the edge of the needle is known. Damage to the foliage is not great enough to injure the tree seriously.

The adult lays eggs from June through August. These are placed under bark scales bordering on crevices. About 60 percent of the eggs are deposited singly or in

pairs. The remainder are laid usually in groups of 3 to 8.

The eggs hatch in from 1 to 3 weeks. The new-born larva mines directly to the cambium, turns, and mines through the innermost phloem tissue next to the wood in an approximately horizontal direction. The mine of the very young larva is at first tiny and scarcely wider than the larva itself. As the larva progresses, it fills the mine behind it with a slender, homogeneous thread of frass.

The life span of the California flatheaded borer is variable. The larva may grow steadily larger and reach the prepupal instar in one season or it may remain small, feeding and progressing slowly throughout the season, and overwinter in this form. When development is slow and the larva remains small, it is termed an "incipient larva;" the mine it makes is healed over by the tree, and the warty ridges typifying this species thus are formed. The tiny "incipients" may survive for 2 or even 3 or 4 years, but mortality is high in this retarded stage. Incipient larval galleries can be found imbedded in the wood of trees that have withstood repeated attacks over a period of years.

When the incipient larvae survive, they eventually enter a phase of development in which growth is rapid. This phase, which usually starts in early June, does not begin until the tree is either dead or dying.

As the larva grows larger, its mine widens progressively and it feeds more extensively, destroying much of the phloem tissue. The full-grown larva constructs a pupal cell in the outer bark or sometimes in the outer sapwood on thin-barked trees. It then stops feeding and becomes a prepupal larva. Generally this stage is reached before

winter and can be found from July on. The insect usually overwinters as a prepupal larva within the pupal cell. Pupation takes place the following spring, mostly in June or from May to July. The insect remains a pupa for about a month and then transforms to an adult, thus completing the life cycle.

Sometimes the insect does not become a prepupa before cold weather, but passes the winter in the actively feeding stage. When this happens, it becomes a prepupa in the spring. Heavy mortality is believed usual with this kind of brood. When the larvae do survive and become prepupae, most of them undergo a diapause. They remain as prepupae throughout the summer and following winter; then they pupate and emerge as adults in the spring.

Biotic Control

Little is known about the climatic and biotic forces that hold flathead numbers in check or about which life stage is most affected. It is known, however, that at times a large part of a brood of larvae die when still very young. Since competition for food is severe between flatheaded borer larvae and other forest insects living in the same tree with them, this lack of sufficient food undoubtedly leads to some mortality of the borer broods.

Small hymenopterous parasites are known to infest the eggs and larval stages of the borer; also the black-bellied clerid (*Thanasimus lecontei* Wolc.) and the blue-green trogositid (*Temnochila virescens* (Fab.)) have been observed attacking the larvae. At times, woodpeckers feed on the prepupal larvae by pecking through the bark to the pupal cell located close to the surface. The effectiveness of these agents in controlling the borer has not been determined.

Artificial Control

Sanitation-salvage logging — a selective cutting of trees of poor vigor — is an effective method for controlling the flatheaded borer in stands of merchantable timber. The selective cutting of decadent trees helps reduce the borer population because such trees usually are most heavily infested. The partial cutting of timber stands may not be economical where a majority of the trees are small or unmerchantable. Also, logging may not be permitted on forest areas devoted to recreational use, so other methods of control may need to be substituted.

The flathead can also be controlled by cutting the tree and peeling and burning the infested bark. This is done during the winter months while the flathead is prepupal and occurs in the outer bark.

Chemical control of the flatheaded borer has proved successful with penetrating oil sprays applied to the outer surface of the bark while the insect is in the larval stage.

The spray formula recommended is ethylene dibromide in diesel oil. The suggested mixture is 1 pint of 85 percent ethylene dibromide concentrate in 5 gallons of diesel oil. The spray is applied liberally to the bark of the felled tree so that the solvent will carry the insecticide to the inner layers of bark tissue where the flathead larvae occur.

CAUTION: The fumes of ethylene dibromide should not be inhaled. Ethylene dibromide and diesel oil are irritants. If spilled on the skin or clothing, they should be washed off immediately with soap and water. The mixture recommended has the flammability of diesel oil and must be handled with the same precautions taken to avoid fires with diesel oil.

Reference

THE CALIFORNIA FLATHEADED BORER (*MELANOPHILA CALIFORNICA* VAN DYKE) IN PONDEROSA PINE STANDS OF NORTHEASTERN CALIFORNIA. A. S. WEST, JR., *Canad. Jour. Res.*, D. 25: 97-118, illus. 1947.

